EWA Report

I. Executive Summary

A. What is an Environmental Water Account

An Environmental Water Account (EWA) is a concept that provides for various water assets to be used to benefit the environment. Water supply would be allocated or purchased to provide benefits to fish and the environment.

B. How was the EWA developed

The concept of an EWA was developed out of a joint effort by water users, project operators, resource agencies, and environmental stakeholders to provide assurances for listed fish species under the proposed CALFED "Through-Delta" Preferred Alternative while maintaining other program objectives (i.e., water supply and water quality). Details of the concept were developed from joint gaming exercises of the group wherein alternative approaches and concepts were tested using system hydrological and project operations models including DWRSIM and a daily hydrological model of the Delta along with available environmental data, particularly historic salvage data from the project fish facilities.

C. How does it work

EWA assets could be obtained in several ways:
1) Shares of new water supply from new facilities.
2) Varing existing environmental standards that limit exports.
3) Purchase of water

Water assets would be held in various forms and locations:
1) EWA water would be held in upstream, in-Delta, and south of Delta surface storage reservoirs, and in ground water projects.
2) EWA assets may include export reduction credits obtained from allotments, exchanges, or purchases.
3) EWA water may be held as options on Sacramento, San Joaquin, or export water.

Use of EWA assets would provide environmental protection in several ways:
1) Cutting exports when direct and indirect impacts to fish from exports are high.
2) Increasing inflow to the Delta when fish need transport flows to get them to Delta.
3) Increasing San Joaquin or Sacramento through-Delta flow to move fish away from south Delta pumping plants

D. How is it funded?

Funds for an EWA would be obtained in several ways:
1) Federal and State appropriations
2) Water user fees
3) Selling of EWA water

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E. What are the potential benefits?

An EWA would provide multiple benefits:

1) Reduced loss of fish at south Delta pumping plants.
2) Improved transport of young salmon, splittail, steelhead, and delta smelt through the Delta to Suisun Bay through reduced exports and/or increased inflow/outflow at most beneficial times of the year.
3) Improved habitat in the Delta and Bay at key times of the year.
4) Indirect benefits to water quality and water supply.

F. What are the potential impacts?

The EWA would have associated impacts:

1) There will be some shifts in impacts from key fish species and life stages to other species and life stages.
2) There will be some changes in habitats from shifts in hydrology in the reservoirs, rivers, Delta, and Bay.
3) Purchase of options, both stored water and exports, would reduce available water supply to agriculture.
4) There may be some changes in water quality from changes in the timing and magnitude of flows, as well as source (e.g., In-Delta island storage).

G. What are the potential costs?

The EWA would have considerable costs:

1) Allocation of water to EWA may affect drought water supplies?
2) Shifts in pumping and storage may require increased pumping costs.
3) Changes in storage and releases may affect power revenues.

H. Who would manage an EWA?

Management of an EWA could be accomplished in several ways:

1) A new management entity.
2) A committee or management team of water users and resource agencies.
3) An existing water management or resource agency.

I. Compatibility with Other Water Users

An EWA would necessarily be managed in close association with water quality and water supply interests not only to balance needs but to gain synergies of joint operation of the water projects in the Central Valley. Compatibility with water quality is achieved by taking stock in the quality of water being diverted or released by the EWA at project facilities, and perhaps avoiding certain actions that may adversely affect water quality. EWA actions that may benefit water quality and the environment, such as increasing outflow and moving brackish water further downstream in the estuary, are given extra credits for the water quality benefits. Compatibility with water supply is achieved by sharing new sources of water and providing sufficient funding to pay any debts from limiting project diversions and deliveries for water supply.

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J. Features Needed for an Effective EWA

During the development and evaluation process for the EWA a number of facilities and capabilities proved essential for an effective EWA.

- Access to storage south of the Delta – EWA water was stored in or borrowed from San Luis reservoir. EWA water may also be stored in groundwater projects.
- Access to storage on Delta Islands – Gaming included 200 TAF of potential storage on Delta islands directly connected to Clifton Court Forbay. The ability to divert and store water independent of the projects when the Delta was in surplus supply for later use in meeting exports demands when the EWA was curtailing exports proved a key asset for the EWA.
- Adequately screened project water diversion intakes in the south Delta were essential in allowing water supply diversions under the expanded Banks capacity.
- The ability to vary standards was necessary to generate EWA water to pay debts derived from limiting project exports at key times of the year.
- A monetary account – funds for purchasing water or water options, pumping groundwater, and pumping to and from Delta storage were essential for obtaining and maintaining an EWA, paying debts to water projects, and reimbursing water users adversely affected by unavoidable effects of EWA actions.

Other features used or contemplated but unused that may contribute significantly to an effective EWA include the following:

- Upstream storage on the Sacramento and San Joaquin Rivers – though not used extensively in the gaming process because of lack of modeling tools, upstream storage capacity for the EWA may allow the EWA to capture and store EWA water or "backup" water for later use when exports are being curtailed by the EWA.
- Ability to vary upstream AFRP standards such as prescribed flow releases from reservoirs to provide EWA water in upstream storage reservoirs.

K. Major Issues/Questions

In the process of developing and refining the EWA concept, and in the subsequent gaming, many issues and questions were raised.

1) What are the baseline conditions from which to operate the EWA? Is it the Accord plus Upstream and In-Delta AFRP? Is it the Accord only? Does it include prescribed future effects of reduced cross-basin transfer from the Trinity River? Does the baseline include flows prescribed in the ERP?
2) How is the EWA expected to evolve during Stage 1 (next 7-10 years) while new facilities and capabilities are developed?
3) What are the EWA objectives? How far do they go? Is the EWA to solve all environmental problems identified by CALFED, or only participate in the overall solution with other programs such as the Ecosystem Restoration Program?
4) What are the future levels of water demands and deliveries within which the EWA will operate?

5) Which Accord standards can be varied to generate water for the EWA? Can such standards be varied at times to generate EWA water without risk to the environment?
6) With much of the new water supply for EWA and water users generated by an expanded SWP pumping capacity from the Delta (up to 10,300 cfs from the existing 6680-8500 cfs), can the environment be adequately protected under the higher export capacity?
7) Will the EWA have sufficient collateral to take on water debt in San Luis reservoir to assure project deliveries?
8) What are the potential indirect effects of changing the hydrological regime in upstream rivers and reservoirs, and in the Bay-Delta with EWA actions?
9) What are the potential effects on water markets from EWA purchases?
10) Are the assumptions used during the gaming process for EWA and potential availability of facilities and funding realistic?
11) Is the available information on fish adequate to accurately forecast future conditions and the ability of the EWA to protect listed species?
12) Are there more effective ways to use EWA assets to benefit the environment, water quality, and water supply?
13) Will the EWA provide adequate protection for ESA listed species?

L. Negotiating Points

The development of an effective EWA will require a consensus among the water users, resources agencies, and environmental stakeholders. The key to a consensus will be working out a consensus on the following negotiating points.

- What new water supply facilities would be developed by the CALFED Program.
- How would these facilities be operated.
- When would these facilities become available particularly in Stage 1.
- What share of the water supply yield of these facilities would go to the EWA.
- What would be the annual funding for EWA.
- What existing prescriptive standards/requirements can be varied to generate water for the EWA.
- What is the extent of borrowing power for the EWA and what collateral will be available for such borrowing.
- What will be the constraints on water market activities by the EWA.
- What will be the EWA priority for use of project storage, conveyance, and pumping facilities.

M. Major Findings

The gaming process resulted in various conclusions on the part of the group.

1) A simple credit approach did not work as well as water account approach in effectively balancing benefits to water quality, water supply, and the environment. Gallon-for-gallon water account approach provided more opportunities, more synergies, and more flexibility. Both approaches offer improvements over existing

prescriptive standards that have minimal flexibility to adjust to specific circumstances and needs.

2) There are many possible strategies for applying an EWA. The best strategy would likely have a capability of adjusting to the specific circumstances. Factors that vary include fish distribution and abundance, environmental factors, etc. These factors would change circumstances and vary need for protection.
3) There are many options or alternatives for performing functions like In-Delta storage. All have different degrees of flexibility, feasibility, and implementation constraints.
4) The best way to meet program objectives using the EWA may be to work out water quality, water supply, and environmental objectives concomitantly.
5) There are opportunities for synergies that would provide long-term benefits to water quality, water supply, and the environment. Each can borrow or count on the resources of the other to help meet objectives within a highly variable and unpredictable system.
6) Opportunities are limited because the water supply is limited. Resources are gained by shifting water supply among years through new storage that captures "surplus" water in wetter years and periods, and distribution facilities that shift transfer water among facilities. Water supply for some users is also gained at the expense of other users through sharing and reimbursement.
7) Because the water supply within and among years is so stochastic (unpredictable and variable), an EWA approach provides a much needed buffering system not only for protection of the environment, but also for water quality and water supply. The EWA provides the collateral to take on risk. In the end, costs are lower than anticipated, because in some years things work out – rain falls. This ability to take on risk benefits everyone.
8) Sharing water supply generated by new facilities and the risks associated with water supply, along with a flexible management approach like EWA, should provide for mutual incentives for long-term benefits for the environment, water quality, and water supply in the future. Flexibility and "extra" resources and facilities will hopefully minimize short-term risks.

N. What is next for EWA – Plans for Addressing Issues - What we can do to resolve them

1. Additional gaming
   - Consider alternative baselines
   - Use different assumptions, facilities, and rules
   - Try alternative strategies
   - Develop new synergies and operational schemes that provide additional benefits
2. Improving gaming and modeling tools
3. Further analyses

Assess impact on water market from EWA water purchases.
Assess impact on water quality
Assess effects on upstream reservoir storage and releases
4. Tying down negotiating points

5. Addressing technical issues

II. Introduction

The following is a status report on the development of an Environmental Water Account (EWA) to be used in conjunction with SWP and CVP project operations in the Central Valley. The report was prepared by members of the EWA Development Team (Team). The report summarizes the essential elements of an EWA including assets and rules. The report also outlines issues, negotiating points, the need for policy decisions, what was learned since the last Phase II report, what additional information and monitoring data are needed, and remaining conflicts and how the Team proposes to resolve them.

A. What is an Environmental Water Account

An EWA is a concept that provides for various water assets to be used to benefit the environment. A portion of the existing and future water supply developed in the Central Valley with the SWP and CVP would be allocated or purchased for use in protecting and enhancing fish and their habitat. The EWA concept is based upon the notion that flexible management of water operations could achieve fishery and ecosystem benefits more efficiently than a completely prescriptive regulatory approach. Regulations place specific limitations on project operations. In general, these limitations are based upon hydrological, seasonal, and biological criteria. For example, under the current export-inflow regulations, the projects are limited to diverting 35 percent of Delta inflow during February through June of most years. An EWA is not a substitute for regulation, but is a supplement to regulation. CALFED's intent is to provide flexibility to achieve environmental benefits and to provide certainty (ESA and other regulatory assurances) to water users. The intent of operations using this account also is to achieve substantial fish recovery while providing for continuous improvement in water supply reliability and water quality benefits.

This proposed strategy would combine the certainty of prescriptive standards with the flexibility of active and adaptive management provided by an EWA as described below. Prescriptive standards provide general ecosystem benefits. CALFED has investigated additional potential prescriptive criteria that could improve ecosystem benefits. Active management, wherein decisions are based on real-time data, permits flexible responses to species whose needs are likely to shift greatly from year to year. Adaptive management promotes improved understanding of species whose sensitivity to entrainment is not well understood. An EWA could provide the flexibility of both active and adaptive management. CALFED will continue to refine prescriptive criteria, the EWA concept, and develop operating criteria in 1999, through the remainder of Phase II. The final operations strategy will likely involve some combination of these elements.

The Team has developed two basic conceptual approaches to the EWA. One is the Credit approach wherein EWA consists simply of water supply and export credits funded from variation of existing prescriptive standards, shares in new water supply facilities, and purchases from a money account. The second is a true water account wherein the EWA consists of real water resources stored in various locations and manipulated by EWA managers to maximize benefits and minimize costs. This approach has been termed the "gallon-for-gallon" approach because it gains and uses assets by applying, trading, or buying-selling on a gallon-for-gallon basis.

The EWA concept was developed to provide additional assurances for listed species during Stage 1 (first 7-10 years) of the CALFED program while program facilities, habitat restoration, and stressor reductions are planned, evaluated, and implemented. It was envisioned that EWA resources such as the money account would be initially high to provide interim protection and enhancement to the environment while further protections were developed by the CALFED program.

The EWA concept was deemed essential given the choice of the "Through-Delta" preferred alternative. Because the Through-Delta Alternative would continue to export water from the south Delta an EWA concept was designed to provide the ability for resource managers to curtail exports when necessary beyond existing constraints to protect fish and Bay-Delta habitat. The concept further involved the ability to vary existing constraints when fish or habitat were not at risk to obtain water for the EWA.

B. How was the EWA developed

The concept of an EWA was developed out of a joint effort by water users, project operators, resource agencies, and environmental stakeholders to provide assurances for listed fish species under the proposed CALFED "Through-Delta" Preferred Alternative while maintaining other program objectives (i.e., water supply and water quality). Details of the concept were developed from joint gaming exercises of the group wherein alternative approaches and concepts were tested using system hydrological and project operations models including DWRSIM and a daily hydrological model of the Delta along with available environmental data, particularly historic salvage data from the project fish facilities.

C. How does an EWA work

The EWA works simply by obtaining, maintaining, and using assets.
EWA assets could be obtained in several ways:

1) Shares of new water supply from new facilities. New facilities would include Expanded Banks capacity (from 6,680 cfs to 10,300 cfs), Joint Point of Diversion (ability to divert from Clifton Court Forebay for SWP and CVP), Delta Island storage (i.e., Delta Wetlands project), and groundwater banks (i.e., Semi-Tropic, Kern, and Gravelly Ford).
2) Variation of existing environmental standards that limit exports. Variation of the Export/Inflow ratio limits on exports, X2 position standard, and outflow standard from the Accord, or Upstream and In-Delta Anadromous Fish Restoration Program (AFRP) requirements could provide water for the EWA if project storage and conveyance capacity are available.
3) Purchase of water or water/export options. Water supplies held in upstream or south of Delta storage could be purchased for the EWA from a money account. Supplies could also be purchased in the form of export reductions, wherein the account would

purchase individual rights to export water. Supplies could be purchased in the form of future options wherein the right to purchase would be purchased at a discounted rate and held but not necessarily exercised. Assets would be purchased from willing sellers in a formal water bank or other available market process.

4) Generating new supplies from "surplus" Delta supply when storage and conveyance facilities are available. There may be opportunities when "surplus" water is available to the EWA for the cost of diversion, conveyance, and storage if "surplus" project capacities are available.

Water assets would be held in various forms and locations:

1) EWA water would be held in upstream, in-Delta, and south of Delta surface storage reservoirs, and in ground water projects.
2) EWA assets may include export reduction credits or options obtained from allotments, exchanges, or purchases.
3) EWA water may be held as water or purchase options upstream in Sacramento and San Joaquin reservoirs, or downstream reservoirs (south of Delta – San Luis reservoir, Los Vacaros, East Side).

Use of EWA assets would be used to provide environmental protection in several ways:

1) Cutting exports when direct and indirect impacts to fish from exports are high. If large numbers of a listed species began showing up in real-time monitoring or salvage facilities in the Delta, then export rates could be immediately cutback. The cutback could be made up by available In-Delta and SOD EWA resources or borrowing from other SOD resources, and thus not affect project deliveries at least in the short term. If project deliveries are necessarily affected, they could be made up later from other sources or in extreme circumstances mitigated through monetary reimbursement via a predefined processes and agreement.
2) Increasing inflow to or outflow from the Delta when fish or habitat would benefit. EWA assets held upstream could be used to increase river flows, Delta inflow, and Delta outflow to the Bay.
3) Increasing San Joaquin or Sacramento through-Delta flow to move fish away from south Delta pumping plants. There may be times when increasing Delta inflow and/or reducing exports would increase through-Delta flow and reduce vulnerability of specific fish to project exports.
4) Increasing reservoir storage upstream of the Delta to improve water quality or future upstream releases. Purchase of upstream storage or exchanging it for SOD storage may provide increase protection available for upstream listed species by providing for (1) higher storage levels in reservoirs that may in turn allow cooler water releases, and/or (2) additional storage releases for fish and their habitat

D. What are the potential benefits of an EWA

An EWA would provide multiple potential benefits:

1) Reduced loss of fish at south Delta pumping plants. By reducing exports and/or increasing Delta inflows at key times, the loss of fish attributable directly and indirectly to south Delta exports can potentially be greatly reduced. Existing data

indicate that fish salvage is seasonal and sporadic, and potentially predictable. Having the ability to adjust flows and exports offers the potential to reduce losses to exports by a large percentage for a small total adjustment in exports with minimal potential cost.

2) Improved transport of young salmon, splittail, steelhead, and delta smelt through the Delta to Suisun Bay. Reduced exports and/or increased inflow/outflow at most beneficial times of the year could improve overall survival as well as reduce vulnerability to export loss for important Delta resident and anadromous fish. For example, reduced exports and increased inflow from the Vernalis Adaptive Management Program (VAMP) is designed to help get juvenile San Joaquin salmon through the Delta to the Bay during a four week period in April and May. The EWA offers the potential to extend the VAMP period when needed to meet VAMP objectives. Similar opportunities have arisen in the past for splittail that spawned in the lower San Joaquin in large numbers, wherein young returned in late spring to the Bay and Delta and were subject to high export losses.
3) Improved habitat in the Delta and Bay at key times of the year. There may be years and times when the potential to reduced exports and/or increased inflow/outflow via the EWA may improve habitat conditions in the Bay-Delta.
4) Indirect benefits to water quality and water supply. The availability of water in the EWA may provide synergistic benefits to water quality and water supply. During gaming the Team observed that EWA often helped water supply get through the summer "low-point" in San Luis reservoir. EWA water releases and export reductions often provided ancillary benefits to water quality by increasing Delta outflow and reducing clorides and bromides in the Delta water supply.

E. What are the potential impacts of an EWA

The EWA would have several potential impacts:

1) Shifts in impacts from key fish species and life stages to other species and life stages. Often in the gaming the Team observed the consequences of protecting salmon and delta smelt was to increase potential impacts on striped bass.
2) There will be some changes in habitats from shifts in hydrology in the reservoirs, rivers, Delta, and Bay.
3) Purchase of options, both stored water and exports, would reduce available water supply to agriculture, potentially leading to less acres in crops and changes in land use from farming.
4) There may be some changes in water quality from changes in the timing and magnitude of flows, as well as source (e.g., In-Delta island storage).

F. What are the potential costs?

The EWA would have potential costs:

1) Allocation of water to EWA may affect drought water supplies. The very fact that the EWA would tie up some potential water supply would translate into less potential water supply during drought periods. Such impacts to water users may require reimbursement from EWA money account.

2) Cost of pumping, storage, and conveyance. Storage, conveyance, and pumping costs will likely accrue to the EWA.
3) Power cost and revenues. Changes in storage and releases may affect power revenues requiring reimbursement by the EWA.
4) Cost of water purchases and options. The EWA will purchase water and water options to partially fund water for the account.

The following sections provide further details on what makes up an EWA, how it functions, results of gaming exercises including issues identified, and what is planned to further develop the EWA in the coming months.

III. Essential Elements

Essential elements of EWA include account generating tools, banking tools, and account use tools. Assets are in the form of dollars, water stored, water credits, and diversion/export credits. Essential elements are those features deemed essential for making EWA effective in reaching its objectives of providing protection to fish species and their habitats.

A. EWA Asset Sources/Rules

EWA assets can come from a variety of sources: payments, share in project yield, variation of standards, borrowing, and use of unused capacities. The following is a summary of the sources and rules used in the Team's gaming process.

1. Payments to EWA

For the purposes of gaming the Team assumed an annual account of $30 million for the EWA. This money was used to purchase water options, water, or other assets. Although not included in the gaming, payments may also be required for renting storage capacity, pumping, conveyance, reimbursements for lost revenues, and power costs.

2. Share of New Facilities

EWA water can be generated from share in new facilities such as Expanded Banks Pumping Plant, new groundwater and surface water storage facilities, and other water supply generating project facilities or operations.

a) Expanded Banks Pumping Plant (SDP)

Expanded Banks and other features of the South Delta Program (SDP) allow exports at SWP to increase beyond 6680 cfs to 8500 cfs and 10,300 cfs. Various suggestions have been put forward on what EWA's share of the expanded Banks capacity should be.

- Share 50/50 all pumping above 8500 cfs.
- Share assets above 8500 cfs using following table

EWA Share under Surplus Conditions

	O	N	D	J	F	M	A	M	J	J	A	S
EWA	0	40	40	40	50	50	50	50	50	40	0	0
Users	100	60	60	60	50	50	50	50	50	60	100	100

- Share only excess capacity (EWA should not share in transfer of NOD to SOD or demands.
- EWA would not have to use resources to pay for limiting diversions to 8500 cfs.
- EWA should share in capacity above 6680 cfs unless under controlled conditions (no excess outflow).

b) JPOD

The EWA could share in the water supply benefits of the Joint Point of Diversion (JPOD) of the projects at Clifton Court Forebay.

c) Enlarged Shasta

Enlarged Shasta would involve replacing the existing 4-ft boards at the top of the spillway with 6-ft boards and increasing storage by 50 TAF at maximum water level. This supply would be developed each time Shasta would fill to maximum and would be available thereafter for release to the EWA.

d) Delta Island Storage

The EWA concept for In-Delta storage involved the combination of Bacon, Woodward, and Victoria islands and an isolated connection to Clifton Court Forebay that would allow pumping to or from the island storage. The islands would have a storage capacity of 200-220 TAF and would have their own screened pumping facilities with a capacity to pump 4,000 cfs onto the islands from various locations in adjoining Delta channels. To minimize water quality degradation from stagnation on the islands, recirculation of Delta water onto and off of the islands was considered. The potential to pump water into the island storage was also envisioned by pumping from Clifton Court Forebay. The Team also assumed that water could be pumped from San Luis directly to the island, although in reality this was more likely to occur as water diverted to Clifton Court Forebay being pumped to the islands through the connector. An added benefit of conversion of the islands from agriculture was a reduction in evapotranspiration of 30-40 TAF per year.

e) Groundwater

Ground water resources were in the form of the Kern Water Bank, Semi-Tropic Project, Madera Ranch Project, or Gravelly Ford project or some equivalent. For the purposes of gaming a total of 400 TAF of groundwater storage was deemed available to the projects and EWA. Input and output capacities were assumed to be 2,000 cfs, respectively. Cost would accrue for pumping to and from groundwater storage. Cost of pumping from ground water was assumed to be approximately $100-200/AF.

f) CALFED Funding of Water Efficiency/Conservation

Another potential source of EWA water was CALFED funding of water conservation. With potential costs exceeding $1000/AF, this option was not included in the gaming.

3. Water from Varying Standards

EWA water can be generated from variation of water quality standards, AFRP requirements, etc.

a) Export/Inflow Ratio

The export/inflow ratio standard can be employed quite frequently to provide EWA water. Experience indicated that EWA water could be accumulated quickly using the expanded capacity of the Banks Pumping Plant. Variation of the standard proved particularly effective in summer when additional pumped water could be used to pay of EWA accrued during the previous winter and spring.

b) X2

Variation of the X2 was not used during the gaming exercise, although its use at times could have generated considerable EWA water.

c) Outflow

Variation of outflow standards was not used during the gaming exercise as outflow standards were deemed necessary to provide minimal environmental and water quality protection.

d) Export Limits

Export limits were varied to various levels during the gaming exercise with capacity allocated to water supply or to EWA if not being used for water supply.

e) DCC and HOR Closure

Closure or opening of the Delta Cross Channel and Head-of-Old-River barrier were sometimes prescribed in conjunction with other EWA actions.

f) Upstream AFRP Flows

Variation or supplementation of upstream AFRP prescriptions were not included in the gaming exercise.

g) In-Delta AFRP

Variation of In-Delta AFRP requirements were not considered. Specific actions were taken at times to supplement In-Delta AFRP requirements to provide protection to fish.

4. Market Purchases/Options/Sales

The purchase of water options and water from a water market with allocated EWA funds was an important feature of the gaming exercise.

a) Options

The following assumptions were used for water options:

- $10/AF for water delivered next year – to be purchased before October 1.
- $60/AF to call options upstream of Delta
- $100/AF to call options in export areas
- All options must be called before April 1 or water reverts to seller.
- Option prices double in dry and critical years.
- Price of calling options increases by 50% in dry and critical years (when projections are greater than 50% for a dry or critical year).

b) Spot Purchases

The following assumptions were used for spot market water purchases:

- $200/AF for first 200 TAF/yr
- $300/AF for next 200 TAF/yr
- etc.
- Add $100/AF for dry and critical years.

c) Sale of EWA Water

The sale of EWA water to water quality or water supply interests were allowed during the gaming exercise with the amount negotiated during the gaming.

5. Borrowing

Borrowing of water supply from San Luis storage was an essential element of the EWA gaming process. Borrowing proved a very cost effective tool during the game because water borrowed often did not have to be paid off. Borrowing was during the December to March period merely delayed filling of San Luis. When the reservoir was subsequently filled, any water debt from borrowing was erased. Borrowing did substantially increased the probability of not filling the reservoir and often required repayment to ensure prescribed deliveries through the summer and fall.

6. Use of Unused Capacities

The EWA may used unused project storage and conveyance capacities, but has low priority. From the gaming experience there appear to be few opportunities to use this capability, at least with the facilities assumed available during the gaming.

7. Demand Shifting

Opportunities exist to shift seasonal project demands/deliveries by up to 100 TAF using reservoir capacities SOD including MWD reservoirs. The shifts may involve forgoing exports in spring and making them up later in summer. This capability was not used in the gaming exercise, but was noted as a possible effective tool.

B. EWA Asset Accounts/Rules

EWA assets can be held in various forms: credits, surface storage, groundwater storage, or in money accounts.

1. Credits

EWA assets could be held simply as credits for reservoir storage releases or exports. In the gaming, only credits held for exports were evaluated. Credits for exports were similar to EWA assets held as water in San Luis.

2. Holdings in Surface Storage

EWA water could be held in any surface water storage facility in the Central Valley. During the gaming EWA water was held primarily in San Luis reservoir or in In-Delta storage. Small amounts were sometimes held in Shasta Reservoir. Purchased water was sometimes held in Yuba reservoirs (Bullard's Bar).

3. Holdings in Ground Water Storage

EWA water was often stored for long periods in south of Delta groundwater banks under the guise of projects such as Semi-Tropic, Madera Ranch, Kern Water Bank, and Gravelly Ford.

4. Money Accounts

An assumption during gaming was that $30 million was deposited in the EWA account at the beginning of each water year (October 1). Money could also be borrowed against the next years deposit. Other rules included:

- Funds accrue interest of 5% / year
- Borrowing costs of 5% / year

C. EWA Application Tools/Rules

Various application tools were applied during gaming with rules.

1. Deferred Exports

The single most-used tool used during gaming was deferred exports. The EWA managers simply requested that planned level of exports be cut back to a specified level, usually one-half that planned. The water was (1) immediately made up by assets held in In-Delta, groundwater, or San Luis storage if available and deliveries were unaffected; (2) borrowed from San Luis water with debt to be made up later and deliveries were unaffected; or (3) deliveries were not made with reimbursement to those affected often with previously negotiated options.

2. Release from Upstream Storage

The most common action involving release of EWA from storage upstream of the Delta involved release of San Joaquin water purchased from water options to enhance San Joaquin inflow in winter and spring. In some cases the water released was allowed to exit the Delta as outflow, while in others it was exported from the Delta, but at a cost of 20% carriage water. Water in storage NOD was sometimes employed with similar rules if exported.

3. Backing up water into NOD storage

Opportunities sometimes occurred when limiting exports to "backup" water into NOD storage and retain in the EWA account. In such cases a 20% credit was given for carriage water.

4. Transfers – Deferring transfers

Transfers or trades of EWA were possible but seldom used during the gaming process. Transfer of EWA water from a location subject to losing the water to a more dependable locations made for a more effective EWA, but at a cost for employing the transfer.

5. Groundwater Pumping

Pumping from EWA groundwater accounts was used effectively at times to make up deliveries and repay debts in San Luis reservoir. The use of groundwater was however limited due to the high cost of getting water to the site and extracting water from the site.

6. Other Companion Tools for EWA/Projects + Rules

During gaming tools for water quality and water supply were applied that had some ancillary benefits to other users. One example was the use of 120 TAF of project storage on Webb Tract in the Central Delta. Another was a $3 million account for water quality to purchase water to maintain water quality at certain times of the year.

IV. Evaluation Approach – Gaming

The development of the EWA and its evaluation involved a gaming process with participants from project operators, resource agencies, CALFED staff, water quality and water supply stakeholders, and environmental stakeholders.

A. Gaming Tools

The gaming process employed various modeling tools including DWRSIM a monthly water supply model developed and maintained by the California Department of Water Resources, and the DailyOps Model developed and maintained by Jones and Stokes Associates. DWRSIM provided the initial baseline conditions for the gaming exercise and the DailyOps Model provided the capability of tracking daily adjustments to the hydrology system from EWA actions. Some aspects of the simulation were handled by hand. The gaming exercise was somewhat hindered by lack of upstream components in the DailyOps Model. The DailyOps Model included fish salvage densities, which allowed adjustments to fish salvage to be tracked by the model when changes were made in export rates. In addition to fish salvage data, limited data were available from fish monitoring programs in the Delta for the simulated period.

B. System Tools/Facilities

The gaming included a variety of system tools and facilities.

1. North of Delta Storage

North of Delta storage included the potential use of the following:

- Project Reservoirs
- Non-Project Reservoirs
- Headwater Reservoirs
- Potential New Reservoirs

2. In-Delta Storage

In-Delta storage included:

- Webb Tract – 120 TAF; 2kcfs in/out; project facility; operated under DW rules.
- Bacon-Woodward-Victoria – 200 TAF; 4 kcfs in; 2kcfs 2-way connector with CCF; forebay with screened intakes in non-dead end channels for projects
- Two-Way connector allows pumping back onto Bacon.

3. South of Delta Storage

South of Delta facilities included:

- San Luis
- East Side
- Los Vacaros

4. Groundwater Storage

Ground water storage included 400 TAF south of the Delta with 100 TAF tied directly to CVP delivery system and 100 TAF tied directly to SWP delivery system.

5. Project Export

Export capability included 4600 cfs for Tracy pumping plant (CVP) and varying export rates for the SWP:

- 6,680 cfs for existing capacity
- 8,500 cfs for presently allowable expanded capacity
- 10,300 cfs for full expanded capacity

6. Project Conveyance

Facilities included for conveyance included:

- Connector between south Delta island storage and CCF.
- Conveyance facilities between CCF and groundwater and surface storage SOD.

7. Export Fish Protection Facilities

Gaming assumed fish screens would be installed at both CCF and Tracy pumping plants, as well as on Delta island storage.

8. Delta Cross Channel

Operation of the DCC would remain unchanged unless specified.

9. Head-of-Old-River Barrier

HOR barrier would remain unchanged unless specified.

C. EWA Water Tools

The following are water generating tools:

- San Joaquin Water Options/Purchases
- Sacramento Water Options/Purchases
- Export Options/Purchases
- Spot Purchases
- Borrowing from San Luis (SOD) Storage
- Borrowing from NOD Storage
- Borrowing from Project In-Delta Storage

D. Water Quality Tools

The gaming process included a $3 million account for water quality purchases. Purchases could take the form of reduced exports or NOD storage releases.

E. Baseline

Baseline conditions for the gaming process generally included the following features:

- 1995 Level of Development/Deliveries
- Accord
- Upstream AFRP
- In-Delta AFRP
- Trinity
- South Delta Program (Expanded Banks Pumping)
- Joint Point Of Diversion
- Ground Water Storage

F. Basic Approach

The Team conducted several simulations to better understand how an Environmental Water Account (EWA) should be structured and function. In these simulations, the EWA controlled a network of high (and low) priority storage rights from Shasta Dam, to Delta Island storage, to the Kern Water Bank. The EWA controlled a series of contracts giving it the right to purchase water in any given year. It had the right to allow variances to the Export/Inflow standard in order to generate environmental water. Finally it had an income of $30 million per year for water purchases.

Using this collection of facilities, contracts, rights, and income, the Team demonstrated that it is possible to make major shifts in Project operations to protect fish and to improve habitat conditions without reducing water supplies to the water users. The Team continues to analyze the extent of the biological benefits generated during the course of the game, but the initial impression from members of the Team has been very positive. A summary of operational insights gained in the gaming process and the level of benefit provided by each is presented later in this report.

Five gaming scenarios have been identified to evaluate the EWA using different assumptions about baseline conditions, EWA assets, accounting approaches, and other criteria. Scenarios will assume assets are in place at a certain periods of Stage 1. Each scenario game will be evaluated for fisheries, water supply and water quality.

The five gaming scenarios include:

Scenario Game No	Baseline Conditions	Period in Stage 1	Accounting Approach
1	Accord +VAMP+All AFRP+Trinity	Middle	Gallon for Gallon
2	Accord +VAMP+All AFRP+Trinity	Late	Gallon for Gallon
3	Accord +VAMP+All AFRP+Trinity	Late	Credit
4	Accord +VAMP+All AFRP+Trinity	Early	Gallon for Gallon
5	Accord + VAMP + without In-Delta AFRP + Trinity	Late	Gallon for Gallon

Choosing the assets that reasonably could be available for the EWA at a certain period of Stage 1 is a difficult task. An example is given below:

G. Example Scenario: Scenario 2- End of Stage 1

This scenario was based on the assets, tools, and facilities to be in place at the end of Stage 1. The DWRSIM base operation studies used as a default for State and Federal water project operations in the absence of an EWA used the following assumptions:

- 1995 Level of Development
- Accord + VAMP
- All AFRP
- Trinity flows
- South Delta Improvements (10,300 cfs at Banks)
- Unlimited JPOD
- Gravelly Ford storage (200 TAF)
- Kern Water Bank storage (200 TAF)
- Shasta Storage (50 TAF)

The possible water supply measures included in this scenario and the sharing between the EWA and the water users is summarized in the following table.

Possible Water Supply Measures	Details	EWA/Water Users Division
South Delta Program -10,300 cfs Banks	10,300 Banks 4,600 Tracy	Users below E/I EWA above E/I
JPOD	No state or Federal sublimits apply	Projects below E/I EWA above E/I
Allow E/I variances		
Allow in-Delta AFRP variances		
Kern Water Bank	300 TAF storage 20 TAF/Mo in & out	200 TAF Projects 100 TAF EWA
Semitropic high priority storage	200 TAF storage 20 TAF/Mo in & out	EWA
Gravelly Ford Groundwater	300 TAF storage 20 TAF/Mo in & out	200 TAF Projects 100 TAF EWA
Shasta Dam Expansion	New 50 TAF storage	EWA
Webb Tract	120 TAF storage 2,000 cfs in/out	Projects
Bacon, Woodward, Victoria	200 TAF storage 4,000 cfs into island 2,000 cfs 2-way connector to CCF	EWA
ET reductions on Delta storage islands	60 TAF/yr average	Project 15 TAF/yr EWA 45 TAF/yr
SOD water purchase options	No limit, but see price schedule	EWA
NOD water purchase options	No limit, but see price schedule	EWA
Spot Purchases	No limit, but see price schedule	EWA
Demand shifting	100 TAF. Short term storage lease in San Luis	EWA
Screen at all south Delta exports intakes	State-of-Art screens at all locations	

Possible Water Supply Measures	Details	EWA/Water Users Division
Access Surplus Capacity		EWA

Other features of this scenario include:

Initial Conditions

- All EWA storage is 50% full at the beginning of the game.
- EWA starts w/ $30 million.

EWA Budget

- $30 million/year, paid on October 1 of each year.
- Funds may accrue.
- The EWA may borrow up to $30 million of future income.
- EWA funds accrue interest at 5% per year.
- Borrowing costs 5% per year.
- Capital costs for assumed facilities are outside the game.
- EWA may build up its fiscal reserves by selling or leasing its rights to water or facilities.

Price Schedules

Discretionary and operating costs must be paid for using the EWA budget. These costs include:

- Cost of options
- Cost of purchases
- Cost of groundwater pumping
- Cost of Project transportation (but with credits for avoided costs from the Projects)

Assumed prices

1. Options

- $10/AF for water to be delivered next year. Options must be purchased before October 1.
- $60/AF to call options upstream of the Delta.
- $100/AF to call options in export areas
- All options must be called before April 1 or the water reverts to the seller.
- The price of options is doubled during dry and critical years.

- The price of calling options rises by 50% during dry and critical years (when projections are greater than 50% for dry or critical)

2. Spot purchases

- $200/AF for the first 200 kaf/yr
- $300/AF for the next 200 kaf/yr
- etc.
- Add $100/AF during years projected to be dry and critical with > 50% probability.

3. Water sales by EWA

Price to be negotiated during game.

4. Groundwater pumping costs

- Kern/ Gravelly Ford at $100/AF
- Semitropic at $200/af

5. Demand Shifting

- $100/AF to rent up to $100/TAF of storage in San Luis from MWD
- Intention to shift storage must be declared by June 1
- Water must be paid back by January 1 of next year or $1000/AF payment

6. Project Transportation Costs

- Should vary by time of year and by the total amount of export pumping.
- As pumping increases, the marginal cost of electricity will increase.
- EWA should pay for extra transportation cost, and get credits for reduced transportation costs.

Water Quality Account

- Up to $10 million/yr.
- Account does not accrue

Water Supply Evaluation

The results from the modeling basis plus water developed at Webb Tract, plus ET gains, plus any efficiency water allocated to the Projects, will roughly represent estimated Project deliveries.

Game Rules

- EWA has the right to carry debt and to use Project facilities, provided it can assure no harm, unless arrangements for compensation are agreed to in advance. Thus, the EWA may borrow against future water supplies, may shift Project storage from upstream storage to downstream storage, etc., provided that it can make the Project's whole before the water is needed.
- Unless otherwise specified, EWA has low priority access to Project facilities.
- Movement of water through the Delta when outflow is controlling has a carriage water cost of 20%. Backing water upstream via export reductions when outflow is controlling reduces carriage water by 20%.

V. Results of Gaming to Date

The following is a discussion of the general results of gaming, what was learned, and what questions and issues raised.

A. General Results of Gaming

Focus during the gaming was generally on storage in San Luis reservoir. Emphasis for operators was to get the reservoir filled as soon as possible for water supply. Emphasis for the EWA managers was to get assets into the reservoir for use when needed to limit exports. Borrowing of reservoir storage to cut exports in winter and spring by EWA generally delayed filling for EWA. After heavy borrowing, emphasis was on refilling the reservoir and paying back debt. At times it was necessary to pay off debts with groundwater assets, NOD storage assets, or by exercising water purchase options.

1. Dry Years(1991, 1992, 1994)

Initial conditions in the fall and winter of these years were low exports and outflow with water quality standards controlling. Actions taken by season were as follows.

Oct-Nov

In beginning of water year available storage on Delta Islands is moved to San Luis reservoir or groundwater. Options are purchased for Sacramento, San Joaquin, and export water. Amount was generally 100 TAF from each source. Some option water may be purchased and delivered into San Luis EWA account.

Dec-Feb

Small winter pulses of inflow to the Delta are shared by water supply and EWA, with EWA getting water from variation of E/I standard and storing the water in San Luis reservoir, ground water, or in In-Delta surface storage.
Export reductions were taken at times to protect winter run salmon juveniles, drawing upon EWA assets in San Luis reservoir, or if necessary borrowing from San Luis storage.

Mar-Jun

Exports were often reduced using San Luis storage assets or borrowing and San Joaquin flows increased using water purchases before VAMP period in mid April. The combined ~~effect generally resulted in increased outflow (by 70-100TAF) in March and early April.~~

To make up for the anticipated debt in San Luis water options were "called" by purchasing the water assets but not delivering it. Any remaining groundwater and In-Delta EWA assets were used to help pay debt in San Luis during VAMP period.

Jul-Sep
Recharge EWA account assets in San Luis and remaining debt payments are made by varying E/I ratio and pumping EWA water to San Luis during the summer. Remaining options for Sacramento and San Joaquin water are purchased and delivered to San Luis to pay any remaining debt or to increase EWA assets in San Luis reservoir.

2. Wet Years (1993, 1995)

Oct-Nov
In beginning of water year available storage on Delta Islands is moved to San Luis reservoir or groundwater. Options are purchased for Sacramento, San Joaquin, and export water. Amount was generally 100 TAF from each source. Some option water may be purchased and delivered into San Luis EWA account.

Dec-Feb
With first large pulse of inflow under wet year conditions both water supply and EWA attempted to refill In-Delta storage and San Luis reservoir assets with expanded export capacity. However because of concerns for high export effects on delta smelt, splittail, steelhead, and salmon, most of EWA assets (San Luis and Delta island storage and export purchase options) and borrowing potential were used to limit exports to or below historical levels. These actions generally delayed filling San Luis reservoir and project In-Delta storage and required use of most EWA assets held in In-Delta and San Luis storage, as well as heavy borrowing from San Luis storage. The high cost to EWA was due to the large amount of exports deferred.

Mar-Jun
With continuing high inflow during these wet years attempts were made to recover some of the winter debt by varying E/I and exporting more water before the VAMP period. Provisions were made to ramp down to VAMP export levels in the week before mid-April and ramp up from VAMP export levels in the two weeks after mid-May. This generally led to higher than historical levels of exports in March and June, while April and May exports were lower than historical levels. Water options were purchased because of the anticipated debt in San Luis from limiting exports in winter and spring in the event San Luis did not fill before summer. Groundwater and In-Delta EWA assets if available were used to pay part of remaining debt in San Luis in late spring after VAMP.

Jul-Sep
EWA debts in San Luis were paid and new assets developed in San Luis and In-Delta storage from water exports allowed during the summer by varying E/I standard. Purchase option water was delivered from the Sacramento and San Joaquin to pay any debt or increase assets in San Luis reservoir.

B. Policy Questions

The gaming process identified various policy questions that need to be addressed for the EWA.

- What new project facilities will be available and when in Stage 1.
- What annual funding will be available for the EWA.
- What share in the water supply from new facilities will go to the EWA.
- What Standards/Requirements can be varied to provide EWA assets.
- What is the potential extent of borrowing power for the EWA.
- What is the extent of water market activity allowed by the EWA.
- What are the priorities for project facilities use by the EWA.

C. Information Needs

The gaming process identified information on which the gaming and application of an EWA would depend. Real-time information in the following areas was deemed essential for an effective EWA.

- Project Operations
- Hydrology
- Biology – fish distribution and abundance, fish salvage at fish facilities
- Water Forecasts

D. EWA Costs Identified

The gaming process identified costs for which the EWA may be accountable.

- Pumping to and from groundwater
- Pumping to and from storage reservoirs
- Pumping from Delta
- Conveyance
- Storage space
- Lost hydropower

E. Other Factors Affecting EWA

The gaming process identified other factors that may affect implementation of the EWA.

- Delta Cross Channel closure
- Head-of-Old-River barrier
- South Delta barriers
- Screening of Clifton Court Forebay and Tracy Pumping Plant intakes

F. Interaction with Water Quality

The gaming process identified interaction of the EWA and water quality.

- EWA actions to reduce exports and increase flows often led to significant improvement in export water quality as measured by TDS, bromides, clorides, and TOC.
- EWA actions to make up water in summer by relaxation of E/I standards could worsen export water quality.

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- Gaming indicated significant pre-existing benefits to water quality from Accord standards.

G. Interaction with Water Supply

The gaming process identified interaction of the EWA and water supply.

- EWA actions often delayed development of annual water supply in San Luis reservoir and In-Delta storage.
- EWA actions and associated debts to water supply on occasion affected water deliveries and interruptible supplies.
- EWA assets held in San Luis reservoir in dry years on occasion helped water supply get through the summer "low-point" problem for water supply in the reservoir.
- EWA assets on occasion could be purchased to help meet deliveries.

H. New project facilities that would benefit all water users

The following new project facilities could benefit water quality, water supply, and the environment.

- Improving capacities to move water in and out of groundwater storage.
- In-Delta storage with connection to CCF
- Expanded export capacity
- More SOD storage
- More NOD storage
- Alternative export intake locations

I. Environmental Benefits of the EWA

EWA actions led to the following environmental benefits:

1) Reduced salvage losses of listed fish species.
2) Improvements in Delta outflow and QWEST
3) Improved timing of exports
4) Shifts in export location from south Delta channels to Delta islands
5) Improved upstream reservoir storage that benefited water temperature and subsequent reservoir releases
6) Improved upstream flows

J. Incidental Environmental Impacts of EWA

The following incidental environmental impacts of the EWA were identified during the gaming process.

- Indirect effects of increased exports and lower Delta inflow/outflow at other times of the year.
- Shifts in impacts to other species (i.e., striped bass).
- Further reductions in flow peaks from exports of EWA water.
- Upstream shifts in X2 in some seasons from exports of EWA water.
- Potential to vary upstream reservoir releases that may have a detrimental effect on upstream fish and fish habitat.

- Potential to cause highly variable Delta hydrology from varying inflow/outflow and exports.

K. What was learned

The simulation exercise yielded the following insights, opinions, and recommendations from the Team:

1. With the proper mix of assets, both fisheries protection and water supply benefits can be achieved with implementation of an EWA.
2. Experience in managing the simulated EWA would allow more efficient use of EWA assets.
3. Monitoring data provided through CMARP would help guide EWA decision-making. CMARP would have to be closely linked to operation of the EWA to help anticipate and avoid or reduce impacts of project operation.
4. Surface storage facilities allow more flexibility than groundwater storage. Groundwater recharge rates limit opportunities to refill the account, while groundwater extraction rates limit use of the account.
5. In-Delta storage would also provide flexibility.
6. There are benefits to purchasing options on water north as well as south of the Delta, just as there are benefits to having access to storage north and south of the Delta.
7. Additional option contracts with south of Delta exporters are helpful.
8. A better mix of tools is needed to provide necessary assurances for listed fish species and water supply.
9. Consideration must be given to how managing the EWA could affect attraction flows needed for upstream migrant salmon.
10. While flows and exports were managed in the simulations to benefit fisheries, the exercise did not allow for directly evaluating potential biological benefits or impacts of actions taken.
11. The EWA has definite potential to provide long term benefits to fishery resources.
12. The EWA gaming and evaluation should continue to refine the size and mix of assets, rules of operation and evaluation and accounting procedure.
13. Delta island storage provided major benefits to EWA.
14. A direct connection from the islands to Clifton Court Forebay added flexibility for storage and alternative diversion points.
15. E/I variances adder major benefits to the EWA especially during dry periods.
16. San Luis low priority storage with its high input/out capacity and space availability most of the time for EWA added major benefits.
17. The ability to purchase water, whether or not water was actually purchased, allowed the EWA to modify export operations with confidence of payback.
18. In drier years, access to markets provided significant amounts of water for EWA.
19. Groundwater storage had clear benefits in dry years; however, low output capacity constrains its value.
20. Efficiency benefits were usable to EWA, but need more at a cheaper cost to be a major benefit.

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21. The synergies of different actions were very beneficial to EWA.
22. EWA had a network of infrastructure/rights which added value greater than the sum of the individual parts.
23. Ability to shift water, focus timing of exports using differentials in environmental sensitivity by time and place was very valuable to EWA.
24. An EWA is not a substitute for regulation, but is a supplement to regulation.
25. An EWA could provide the flexibility for both active (decisions made on real-time data) and adaptive management.
26. An EWA could add substantial environmental benefits while providing certainty (ESA and other regulatory assurances) to water users.
27. The EWA could be treated much like a water contractor with a portfolio of assets including money, water, entitlement to capacity in diversion, storage, and conveyance facilities.
28. The accounting system can either be a strict contract approach for water each year or a gallon-for-gallon approach of accounting of water transferred to water contractors for makeup when EWA curtailed pumping, or a combination of both.
29. Borrowing from surface storage is effective – often debt does not have to be paid if storage refills in wet year.
30. Strategies for water quality and environment could be improved through more effective purchase and use of WQ and EWA water.
31. Environmental regulations limited the use of the EWA.
32. Export reductions could not be backed up into NOD storage because of minimum flow requirements from NOD storage reservoirs.
33. There were considerable benefits and insights gained through daily modeling.
34. There were many benefits of all parties participating in managing water and working toward meeting everyone's objectives.
35. Credits allocated in the Credit Scenario were too low to provide adequate protection and water supply benefits were too high.
36. Independent control of resources did not seem to work – better to work together to maximize efficiency.
37. Employing and EWA beginning in Stage 1, year one, with minimal facilities was successful in making it through two dry years and one wet year.
38. As the game became more sophisticated more opportunities for multiple benefits came to light.
39. Credit approach tended to become more complicated than gal/gal accounting approach as it was necessary to make exceptions to credits, and it was difficult to forecast what credits should be under different hydrologic conditions.
40. SOD and near pump storage are a premium in allowing the EWA to work under a flexible approach. Storage closest to the pumps allows the most flexibility.
41. Use of groundwater is limited for the EWA given the low recharge and extraction rates, because the EWA requires large volumes of water in a relative short periods of time.
42. Groundwater is often used as collateral with the water users for debt incurred by the EWA to the water users.

43. The governance of an EWA has to be set up so it can make quick decisions on purchases, movement of water and or/storage options.
44. Need to factor in risk of being able to purchase and deliver water when called by EWA actions.
45. Very important to establish the right sharing formula for new facilities otherwise giving the Projects unencumbered control over large increases in export capacity creates instability in the game and the EWA could be bankrupted, or fish protections compromised.
46. With fewer assets in the EWA in the scenario starting in year 1 of Stage 1, the resource agency members of the Team were more comfortable with prescriptive standards than an EWA.

VI. Issues/Concerns Raised during Gaming and Potential Solutions

A. Baseline: What should EWA address

The baseline was always an issue during the gaming exercise. The baseline was necessary to define what was already covered and what was not. Baseline questions were raised for the following features:

- Upstream AFRP actions
- In-Delta AFRP actions
- Future upstream depletions and demands/deliveries from Delta
- Trinity flows
- Groundwater facilities
- Expanded Banks Pumping Plant
- JPOD
- Screened Clifton Court Forebay and Tracy Pumping Plant
- Flow objectives of the ERP
- Water Quality

B. How much of CALFED Environmental Objectives should be shouldered by EWA given potential benefits of ERP?

This was an important issue as it related to the objectives of the EWA. Water users argued that the many habitat benefits of the ERP should limit the need for protection from the EWA. Resource agencies argued that the benefits of the ERP are far off and unproven, and that protection of listed species was a primary objective of the EWA.

C. What are short and long term objectives of EWA?

It was argued that the objectives of the EWA could change over time depending on results obtained from the EWA and other CALFED programs.

D. Should EWA require changes in WQCP?

Often at issue in the process was whether changes in Accord standard other than the E/I ratio could be considered for the EWA and water supply. Eventually there was some leaning for potentially relaxing X2 standards to obtain additional water for EWA.

E. Should Accord standards be revisited

EWA changes could affect the baseline under which the Accord standards were developed thus raising the question as to whether some Accord standards such as export restrictions and outflow limits should be revisited.

F. Realism of Gaming

The realism of the gaming exercise was often an issue.

Salvage data: Use of salvage data to guide exports, especially with changed flows and exports was questioned. Would density of fish change with changes in export rates? Would fish distribution change in the Delta with changing export rates and inflows? Would fish be more or less susceptible to exports?

Years simulated: The specific sequence of years used in simulation, 1991-1995, was an issue. Should years and months within years be randomized?

Water market pricing: Was the water market pricing and the ability to convey purchased water used in the gaming exercise realistic?

In-Delta storage: Was use of In-Delta storage realistic given potential costs and water quality problems?

Groundwater: Were the groundwater resources used in the gaming exercise real and would they be available to the EWA?

G. EWA having a large debt in San Luis.

There was consider concern over the large debts developed by EWA in San Luis storage during the gaming exercise. How much of this resource could be borrowed before water users would balk at such use? What collateral would be offered to alleviate water user concerns? Was the accounting of the debt unrealistic given the exercise had given control of 17,000 cfs of export capacity to water users?

H. Indirect Environmental Effects

There was considerable concern over potential indirect effects on the environment from EWA actions. For example, actions often resulted in much higher predicted impacts to striped bass. In some years total exports were increased over historical levels, bringing concern that indirect effects such as on habitat or other species may be significant. Concern was also expressed for changes in upstream flow patterns, as well as changes in upstream storage levels.

I. Benefits of new fish facilities in south Delta

An issue often brought up was the potential benefits of new fish screens in the south Delta and whether they would allow expanding exports. Some argued that the benefits of the screens should allow expanded exports, while others argued that indirect effects of higher exports were still important.

J. Delta Island Storage

The use of Delta island storage for water supply and the EWA was often an issue particularly for export water quality. Some argued that export water quality would be seriously compromised by the use of Delta island storage. Others argued that use of screened intakes on the islands would have advantages over exporting through new screens of south Delta pumping plants. Others argued that there were alternatives to Delta Island storage that did not have these problems. Options were considered that may reduce the potential adverse effects to water quality:

- Recirculate water on islands
- Have subchannel to convey water when island is empty to limit picking up soil.
- Dig out the peat (easier on Victoria). This has the added benefit of increasing storage potential, increasing the depth of storage, and providing fill.
- Reduce the residence time on Bacon Island. Evacuate this island very quickly after filling, either moving the water into Victoria, or moving it south of Delta.

K. Better ways to use EWA.

A continuing argued was made for better ways to implement EWA and use its assets more effectively. For example, in the gaming exercise, EWA assets accumulated in dry years and were relatively unused, while they were heavily used in wet years. Some argued that more of the resources should be allocated to dry years. Others argued that the rules of the game (i.e., giving control of expanded Banks to water users) necessitated using resources in that way.

L. Ineffective use of resources.

A common issue was whether resources were being used effectively. Some argued against using EWA assets to reduce spring exports given new fish screens. Others argued that money account should be used to improve habitat rather than purchase water.

M. Expanded Banks

The high export capacity with an expanded Banks pumping plant (up to 21,000 cfs with Delta islands) was itself and issue for many. Such exports were far above histical levels and some were concerned that we could not predict the potential consequences of such high export levels with the available information. These concerns were amplified when the high export rates were employed in dry years or when relaxing an existing E/I standard.

N. Potential effect on water market from EWA involvement

An issue often brought up was the potential effect of $30 million dollars from the EWA on the Central Valley water market. Other questions that came up included the following:

- Will a spot market exist that will allow the EWA to purchase water virtually instantaneously?
- What regulatory process will the EWA need to go through for purchased water?
- Will the process be efficient enough to allow use of the water within a few months of purchase?
- Can upstream purchases be delivered in a short-term pulse (as was done in July of 1993)? Or must they be delivered over a longer period (e.g., via reduced diversions by local agricultural districts)?
- If spot markets are unreliable, and the regulatory process time consuming and uncertain for annual purchases, then we may need to think about longer-term water purchases by the EWA. We could lease water for 10 –20 years or even purchase a water right. Then, we would need to do the environmental documentation up front, but would thereafter be able to rely heavily upon this water. The water would also represent better collateral for the Projects.

O. Timing of EWA actions and new project facilities

A common issue was the potential timing of new project facilities and whether it was realistic to think that the resources could be developed at any time in Stage 1.

P. Timing of other CALFED Program actions

Similarly, at issue was whether CALFED actions such as the ERP water actions would be developed in Stage 1 and provide benefits to listed species.

Q. Comparison against historical conditions

A contentious issue often argued was whether comparisons of simulation outputs should be made with historical conditions. This was surprising given the simulations involved the years 1991-1995. Baseline demands and deliveries used in the simulations turned out to be higher than historically occurred in those years. Some argued that we should stick with the new agreed upon baselines while others argued for comparison of results with both historical and new baseline conditions. Others argued that the Accord standards and agreements would not be applicable under new higher demands and deliveries.

R. Closure and effect of DCC

The DCC, HOR barrier, and south Delta barriers were sometimes an issue.

S. Adequacy of Protection for ESA species

The adequacy of protection to listed species was often in question during gaming exercises given the many questions, assumptions, and uncertainties inherent in the process.

T. Demand Shifting

It was assumed that arrangements to shift demands with MWD will be available every year, provided that it is decided to shift demands by some date (June 1?). This too is questionable, unless a multi-year agreement with MWD is negotiated in advance.

U. Groundwater deposits/ extractions

It was generally assumed that capacity always exists within the EWA groundwater basins to deposit water into the ground and to extract it from the ground. The only exception was in the March game when it was assumed that Kern would not allow the EWA access to groundwater extraction during dry and critical years. Again, there is a need to determine what is feasible. The reliability of the groundwater for the EWA and as collateral for the Projects probably depends, once again, upon the development of a multiyear agreement defining EWA access to groundwater and assuring that access.

V. Standard Variations.

It was assumed that the EWA may grant variations to the E/I ratio and to the in-Delta AFRP requirements. Moreover, the variations can be granted virtually instantaneously. This is an optimistic assumption. First of all, it implies a degree of unified decision making that does not now exist. Experience has been that there have frequently been problems when decisions were needed quickly, simply because of the number of people who needed to sign off and because of the different responsibilities of the participating agencies. The need for rapid analysis and decision making has major implications for the institutional structure of the EWA. However, assuming that the EWA has the correct institutional structure to make decisions quickly, there is likely to be another layer of regulatory oversight. If the EWA desires to vary the E/I, will it need the pre approval of the SWRCB? If it wishes to vary an AFRP requirement, will it need the pre approval of DOI?

W. Reliance on transfers.

EWA appeared to be hampered significantly in efforts to protect ecosystem by regulations, which seemed ironic. Delta storage could not be filled on several occasions, despite opportunities and low impacts. Similarly, AFRP regulations may hinder decision making. July pumping was constrained, despite major benefits to water quality and minimal environmental impacts because of AFRP

X. Daily versus Monthly Operations Models

A common issue during gaming was which model provide the most accurate information. DailyOps model appears to show that DWRSIM overstates possible exports. When flows fluctuate rapidly, opportunities decrease for two reasons: (1) DWRSIM averages inflows, allowing spikes to be spread over the entire month and (2) the E/I ratio is based upon a 14 day average inflow and cannot follow rapid increases in inflow. In 1993, the Daily Ops model showed a 1 MAF difference in total exports. This helps to resolve the paradox noted by some that historical diversions are much lower than future projected diversions. It also increases the importance of E/I variations and peaking capacity ~~represented by the Delta islands~~

Y. San Luis Low Point

In most years, the Projects attempt to operate SLR such that minimum storage (in August) is greater than some specified amount. This carryover storage will constrain Project deliveries. The existence of EWA water in San Luis in the late summer allows the Projects to deliver water below their previous low point. Another way of putting it is that the EWA is providing the dead storage in San Luis, or that the Projects are borrowing EWA storage in San Luis. The Projects will not necessarily gain water supply out of this maneuver. If San Luis doesn't fill and the EWA doesn't have storage in San Luis the next summer, the projects would have to reduce deliveries and would be right back where they started. But when SLR fills, the Projects will have increased their deliveries. Conceivably, a similar phenomenon could take place in other reservoirs (e.g., if EWA has water stored in Shasta, the water might count toward the 1.9 maf carryover target), though this is less likely.

Z. General EWA Issues

The gaming process identified a number of general issues:

- How big does the EWA need to be and what is it's mix of assets?
- What type accounting procedure should be used?
- What are the biological priorities for EWA water use?
- How should the benefits of the EWA be evaluated?
- Who pays for the purchasing fund and other costs of the EWA?

VII. Planned Activities

The Team plans to continue their efforts to develop the EWA in the coming months. Activities include the following:

1. Address Issues - What we can do to resolve them.
2. Conduct further analyses
3. Tie down negotiating points
4. Develop closer ties to other CALFED programs
5. Get management decisions
6. Conduct further gaming exercises
7. Consider alternative baselines including:
    - Without In-Delta AFRP – these actions would be met if necessary with EWA assets.
    - No Baseline – the Team would simply manage for multiple objectives.
8. Develop more cooperation and coordination among EWA, WQ, and WS during gaming.
9. Develop additional modeling tools –
    - Develop an upstream component to the DailyOps model.
    - Develop a daily salvage component to the DailyOps model.

- Automate existing DailyOps model to execute operating decisions based on rationale used during gaming.
- Incorporate water quality and water supply objectives into DailyOps model.
- Improve the computational efficiency of the DailyOps model.
- Enhance the output graphics and reports from the DailyOps model.

10. Simulation should include years 1995-1999 with real-time survey data – less reliance on salvage data
11. Game real-time Year 2000